Forecasting Techniques & Regression Analysis

🌞 1. Purpose of Forecasting in Planning

- **Forecasting** helps estimate future outcomes using **assumptions (premises)** about business conditions.
- **Premises** = assumptions about future events that affect business success.
- Only focus on **relevant premises** that impact results (e.g., inflation, economic growth).

🚻 2. Forecasting Techniques Overview

Once premises are identified → forecasts are made using **mathematical models**.
A **mathematical model** expresses relationships in equation form.

Example:
If each product sells for $1,000 →
R = 1,000x
Where R = total revenue, x = units sold.

📈 3. Linear Regression Analysis (Key Forecasting Tool)

Regression estimates how one variable (dependent) changes with another (independent).

Term	Meaning
Dependent variable (Y)	The outcome or value being forecast
Independent variable (X)	Predictor or causal factor affecting Y

Purpose:
To predict **future Y** values using historical relationships.

🧮 4. Types of Regression-Based Forecasting

(A) Time Series Methods

- Looks only at *one variable's* historical data over time.
- Time (X) is the **independent variable**, and the measured value (Y) is the **dependent variable**.
- Identifies patterns: trend, seasonal, cyclical, irregular.

Common Pattern:
👉 **Trend Pattern** — long-term upward or downward movement.

Example Equation:
$\hat{y} = a + bx$
Where:

- $\hat{y}$ = Predicted value of Y (Y-hat)
- a = Constant coefficient (y-intercept)
- b = Variable coefficient (slope)
- x = Independent variable (time)

Example:
$\hat{y} = 2{,}181{,}000 + 92{,}636x$
For Year 11 → $\hat{y} = 3{,}199{,}996$

Interpretation:

- **a (Intercept):** Value of Y when X = 0.
- **b (Slope):** Change in Y for each unit increase in X.
- **ŷ (Y-hat):** Forecasted (not actual) value of Y.

Goal: Find the **line of best fit** (minimizes deviations between actual and predicted values).

(B) Causal Forecasting Methods

- Used when Y depends on **one or more other variables**.
- Forecast based on **cause-and-effect** relationships.

Example:
Sales revenue (Y) depends on advertising expenditure (X).

Steps:

1. Use historical data to confirm correlation.
2. If relationship is linear → use regression to forecast.

⚠️ **Important:**
Correlation ≠ Causation.
A high correlation doesn't always mean one variable causes the other.

📊 5. Multiple Regression Analysis (Advanced Causal Forecasting)

Used when **more than one independent variable** affects Y.

Example:
Sales revenue depends on:

- Advertising spend (x_1)
- Sales staff size (x_2)
- Economic conditions (x_3)

Equation:

$\hat{y} = a_o + a_1x_1 + a_2x_2 + ... + a_kx_k$

Where:

- a_o = constant (intercept)
- $a_1, a_2, ... a_k$ = coefficients for each independent variable
- $x_1, x_2, ... x_k$ = independent variables

Graphically:
Forms a **regression plane** instead of a line.

✅ 6. Benefits of Regression Analysis

- **Objective & quantitative** — results are data-driven.
- Useful for **budgeting** & **cost analysis**.
- Helps separate **fixed** and **variable** portions of **mixed costs**.

⚠️ 7. Limitations of Regression Analysis

1. Requires **historical data**.
2. Not reliable if **conditions have changed** significantly.
3. **Wrong choice** of independent variable → misleading forecasts.
4. Valid **only within data range** used in the analysis.

🧠 8. Key Exam Reminders

- Understand & apply:
  $\hat{y} = a + bx$ and **$\hat{y} = b_o + b_1x_1 + b_2x_2 + ... + b_kx_k$**
- Be able to:
  - Identify slope and intercept.
  - Calculate $\hat{y}$ for a given X.
  - Interpret regression results.
- Correlation ≠ causation (logical cause must exist).
- Regression line = **trend line** in time series data.

📘 Quick Formula Summary

Concept	Formula	Meaning
Simple Linear Regression	$\hat{y} = a + bx$	Forecast using one independent variable
Multiple Regression	$\hat{y} = b_o + b_1x_1 + b_2x_2 + ... + b_kx_k$	Forecast using multiple independent variables
Slope (b)	Change in Y / Change in X	Rate of change
Intercept (a)	Value of Y when X = 0	Base level
Forecast ($\hat{y}$)	Predicted Y value	Future estimate